

Causal Nexus between Government Debt, Exports and Economic Growth for Three Eurozone Countries: A Panel Data Analysis

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Abstract

The relationship between government debt, exports and economic growth has been the focus of a considerable number of academic studies in recent years. The economic crisis, which started in the United States mortgage market, quickly went global when mortgage-backed securities traded by financial institutions. Europe's response was immediate regarding the measures to tackle the crisis. The establishment of common strategies was the long term goal of the European Union (EU). This paper examines the relationship between government debt, exports and economic growth in the EU countries with the highest level of government debt, using panel data over the period 1990-2014. The Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) methods are used to estimate the long run relationship between the variables. In addition, the Vector Error Correction Model (VECM) is used in order to investigate the causal relationship between the examined variables. The empirical results of the study revealed that there are both short and long run relationships. Findings suggest that there is a unidirectional causality running from exports to economic growth as well as from exports and economic growth to government debt. The results provide evidence to support the export led-growth hypothesis. Exports are an important factor for economic development. Moreover, the results reveal that government debt is affected by exports both directly and indirectly through economic growth. Policy implications are then explored in the conclusions.

Keywords

economic growth, exports, government debt, panel analysis, vector error correction model, causality

1. Introduction

Since 2007, the global economy is facing a great financial crisis. The financial crisis started as a USA (United States of America) subprime mortgage crisis and was spread quickly in the real economy of the country, influencing investments, trade, unemployment rate, etc. The interdependence of the financial markets had as a result the transmission of crisis in Europe. The reduction in consumer demand for the European products in USA made the situation even worse.

The international financial crisis, which started in USA and extended internationally, has influenced and continues to influence negatively most of the European countries. In Europe, the crisis affected initially the Eurozone countries and then expanded on Balkans. The recession in the real economy of the Euro area, shook the financial stability of the Eurozone and led to the public debt crisis (e.g., Greece, Portugal, etc.).

Even today, six years after outbreak of the crisis in Europe, there are still European countries that are facing serious structural and financial problems. Most of them belong to the Euro area. However, the causes of the crisis in each country were different. In several countries the private debt was transferred to the public debt as a result of the bailout of the banking system. So, it was difficult or impossible for them to repay or refinance their debt without the help of the European Central Bank (ECB) or the International Monetary Fund (IMF).

Lending problems in the southern European countries has hurt their productive structure. On the other hand, this has favored the northern countries. Debt problems and bankruptcy risk of their national banks have shaken the European economic system and have raised questions about its durability. Therefore, the challenge that Europe has to face is the twin deficits: fiscal and competitiveness.

The last few years, there are several discussions among economists about how these countries will recover achieving high growth rates and low unemployment. All economists agree that the promotion of exports is one of the few realistic pillars to face economic crisis. Exports can be the impetus for foreign investments, can improve the competitiveness and can help a country to integrate in the world economy. The importance of exports in economic process cannot be disputed. Exports, in combination with other relevant variables, such as government debt, exchange rate, inflation are the most important factors in the process of economic development. During the period of crisis (from 2009 until 2014) exports of goods and services in Greece, Italy and Portugal has increased 17.8%, 35.1% and 32.6% respectively (AMECO, 2015).

The purpose of this paper is to examine the relationship between exports, government debt and economic growth in three Eurozone countries (Greece (GR), Italy (IT) and Portugal (POR)) using annual data covering the period 1990-2014. The government debt-GDP ratio of these countries has increased steadily since 1990. In 2014, Greece, Italy and Portugal were the three Eurozone countries with the highest government debt-GDP ratio (see Figure 1).

Few papers have examined the relationships between these three variables in developed economies and have used the causality analysis. Also, there are even fewer studies that carried out their analysis in the

panel framework.

This paper is organized as follows: Section 2 briefly reviews the literature. Section 3 presents data and econometric methodology. Section 4 presents the empirical results. Concluding remarks are given in the final section.

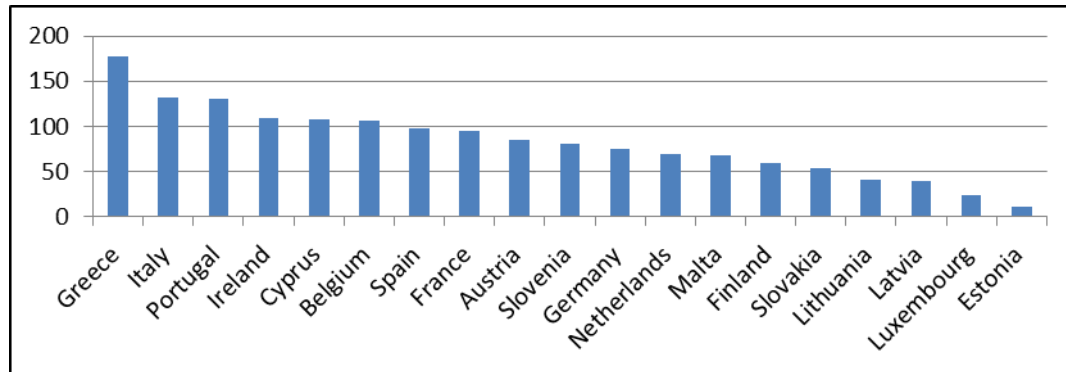


Figure 1. Government Debt-GDP Ratio in the 19 Eurozone Countries (2014)

Source: Authors, using data from IMF (2015) and AMECO (2015).

2. Literature Review

There are several studies in the literature that examine the relationship between debt and economic growth both in developed and developing economies using either time series or panel data. However, the bivariate analysis leaves out some other relevant variables such as exchange rate, inflation, exports that could have a significant relationship with the above two variables.

Karagol (2002) explored the causality relationship between external debt service and GNP (Gross National Product) for Turkey during 1956-1996. He found that there is a negative unidirectional causal relationship between debt service and GNP level with direction from debt service to GNP. Granger causality results show that debt service is an important factor of GNP. The existence of this type of causality may be due to the fact that borrowed resources are misallocated or wasted on consumption.

Ogunmuyiwa (2011) examined if external debt promotes economic growth in Nigeria using time series data from 1970-2007. For this purpose, the Vector Error Correction Model (VECM) and Granger causality techniques were employed. The results of this study indicate that there is no causality between external debt and economic growth. So, as causality cannot be established between external debt and economic growth in Nigeria, changes in GDP cannot be predicted with changes in external debt. Most developing countries, contract debt for selfish reasons rather than for the promotion of economic growth through investments in capital formation.

Saad (2012) investigated the relationship between economic growth, exports and external debt servicing in Lebanon for the period 1970-2010 with the inclusion of a fourth macroeconomic variable that is exchange rate. In this study, the Vector Error Correction Model (VECM) and Granger causality techniques were used. Findings suggest that there is bidirectional Granger causality between GDP and

external debt servicing, a unidirectional Granger causality running from external debt to exports, a unidirectional causality that runs from exports to economic growth and a unidirectional causality that runs from exchange rate to economic growth. The above results validate the exports-led growth hypothesis. Exports are considered as an important factor in the process of economic development. Exports can cause scare in foreign exchanges reserves that are required to finance imports of goods (such as energy), which are substantial for the formation of capital and the promotion of growth.

A similar study (Dritsaki, 2013) examined the relationship between economic growth, exports and government debt for the case of Greece using data over the period 1960-2011. The results of Vector Error Correction Model (VECM) showed that in the short run there is a unidirectional Granger causality running from exports to economic growth as well as from economic growth to government debt. In the long run, the results reveal that there exists a unidirectional Granger causality running from economic growth to government debt. The presence of a causal link between exports and economic growth is very important for policy making in the developed countries. The results of the study provide evidence to support the export led growth model. So, exports can play a vital role in the process of economic development.

Regarding studies that examine the interactions between these variables in a group of countries, Schclarek (2004) examined the relationship between debt and growth for 59 developing and 24 industrialized countries with data averaged over each of seven 5-year periods between 1970 and 2002. For developing countries, the results show that there is a negative and significant relationship between total external debt and economic growth. Further, this negative relationship is driven by the incidence of public external debt level and not by private external debt levels. In the case of industrial countries findings reveal that there is not any robust linear or non linear relationship between total external debt and economic growth. These results are in clear contrast with the results for developing countries. For industrial countries higher public debt levels are not associated with lower growth rates.

Presbitero (2005) used dynamic panel estimations to examine the relationship between external debt and economic growth in poor countries. The results for a panel 152 developing countries over the period 1977-2002 show a negative linear relationship between external debt and economic growth, and between debt service and investment. The negative effects of external debt on economic growth are due to the crowding out of the public investments. These effects are found to be stronger in the low income countries than in the overall sample creating questions about the major effect that debt has in the world's poorest economies.

Ferreira (2009) investigated the relationship between public debt and economic growth for 20 OECD countries using panel data over the period 1988-2001. The results revealed that there is a clear bidirectional causal relationship between the above variables. Findings point out that public debt restrains economic growth. Moreover the results show that economic growth influences the evolution of public debt.

A similar study (Ferreira, 2014) investigated the causality relations between economic growth and three

debt categories (public, foreign and private) in the 28 EU countries using data covering the period 2001-2012. Granger causality results show that there is not statistically significant causality between economic growth and foreign debt and that the causal link among private debt and GDP growth is of limited importance. On the other hand, findings reveal a statistically significant bidirectional causality relationship between public debt and economic growth. This relationship appears to exist before and after the outbreak of the global financial crisis. The evidences support the clear contribution of economic growth to public debt reduction.

In general, the literature suggests that the causality relations depend on the country (developed or developing) and its specific characteristics, the econometrical methods and the period that the studies carried out. The results can be unidirectional causality, bidirectional causality or no causality relation.

Table 1. Summary of Studies Showing Causal Link among Economic Growth and Debt

Authors	Study Area & Period	Variables	Method	Main Results
Group 1: studies using time series data				
Karagol (2012)	Turkey 1956-1996	External debt service, GNP	Granger Causality, VECM	Debt → GNP
Ogunmuyiwa (2011)	Nigeria 1970-2007	External debt, GDP	Granger causality, VECM	No causality
		External debt		Debt ↔ GDP
Saad (2012)	Lebanon 1970-2010	service, Exports, GDP, Exchange rate	Granger causality, VECM	Debt → Exports Exports → GDP Exchange rate → GDP
Dritsaki (2013)	Greece 1960-2011	Government debt, Exports, GDP	Granger causality, VECM	Exports → GDP GDP → Debt
Group 2: studies using panel data				
	59 developing countries			Negative relationship between external debt and GDP
Schclarek (2004)	1970-2002 24 industrialized countries	External Debt, GDP	GMM dynamic panel	No relationship between external debt and GDP
Presbitero (2005)	152 developing countries 1977-2002	External Debt, Economic Performance	GMM-System	Negative relationship between external debt and growth
Ferreira (2009)	20 OECD	Public Debt,	Granger causality	Public Debt ↔ GDP

	1988-2001	GDP	techniques	
		GDP, 3 debt		
Ferreira (2014)	28 EU countries	categories	Granger causality	GDP ↔ public debt
	2001-2012	(public, foreign, private)	techniques	

3. Data and Methodology

3.1 Data

The multivariate panel framework includes annual data of Gross Domestic Product (GDP), Exports of Goods and Services (EXP) and Government Debt (GD) for three Eurozone countries (Greece (GR), Italy (IT) and Portugal (POR)) over the period 1990-2014. All variables are measured in 2010 constant prices (expressed in billions euro). All data derive from the databases of Annual Macro-Economic (AMECO, 2015) and International Monetary Fund (IMF, 2015). The descriptive statistics of different variables for three countries are given on Table 2.

Table 2. Descriptive Statistics

	EXP	GDP	GD
Mean	144.4853	625.2196	488.8379
Median	51.09698	189.8624	176.7077
Maximum	455.2480	1687.963	1855.830
Minimum	17.05767	124.5115	28.06968
Std. Dev.	155.3368	641.7254	563.7206
Skewness	0.911112	0.733490	1.051381
Kurtosis	2.079057	1.586.919	2.593085
Jarque-Bera	13.02700	12.96510	14.33496
Probability	0.001483	0.001530	0.000771
Observations	75	75	75
Cross Sections	3	3	3

3.2 Econometric Methodology

Following Saad (2012), we specify the production function as follows:

$$GDP_{i,t} = \alpha_i + \beta_1 EXP_{i,t} + \beta_2 GD_{i,t} + u_{i,t} \quad (1)$$

where: $GDP_{i,t}$ = Gross Domestic Product, $EXP_{i,t}$ = Exports of Goods and Services, $GD_{i,t}$ = Government Debt, α_i = Intercept, β_1 = Estimated coefficient of EXP , β_2 = Estimated coefficient of GD , $u_{i,t}$ = Error term, i = the number of individual members and t = the number of observation over time.

After descriptive statistics, this paper uses panel unit root tests to examine the stationarity of the three variables and then panel cointegration analysis to investigate the long run relationship among them. The Fully Modified Ordinary Least Square (FMOLS) and the Dynamic Ordinary Least Square (DOLS) methods are used in order to estimate the long run relationship between the relevant variables. Finally, a dynamic panel Vector Error Correction Model (VECM) is used in order to find the short and long run Granger causal relationships between exports of goods and services, government debt and economic growth for the three Eurozone countries (GR, IT and POR).

3.2.1 Panel Unit Root Tests

The first step in panel causality analysis is to define the order of integration of the variables included in the study. In recent econometric literature, there are several approaches for testing unit roots in panel data. Taking under consideration that these methods may give different results, we use tests proposed by Breitung (2000), Levin, Lin and Chu (2002) (LLC), Im, Pesaran and Shin (2003) W-test (IPS), ADF Fisher Chi-square test (ADF-Fisher), PP Fisher Chi-Square test (PP-Fisher), Maddala and Wu (1999), and Hadri (2000). In all these cases, except Hadri the null hypothesis is that the variable contains a unit root (i.e., it is not stationary) (For details on the description of the above tests see Appendix A).

3.2.2 Panel Cointegration Tests

After establishing the stationarity of the series by determining the order of integration, we continue applying panel cointegration tests. Three types of tests were conducted proposed by Pedroni (1999, 2004), Kao (1999) and Maddala and Wu (1999). Pedroni (1999, 2004) introduces seven panel cointegration statistics. Four of these are based on within-dimension and three are based on between-dimension. The null hypothesis of no cointegration for the panel is the same for each statistic $H_0 = \rho_i = 1$ for all i . However, the alternative hypothesis differs. For the between-dimension test statistics the alternative is $H_1 = \rho_i < 1$ for all i , while for the within-dimension statistics the alternative is $H_1 = \rho = \rho_i < 1$ for all i . The second test which applied is proposed by Kao (1999). Kao (1999) uses Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) type tests under the null hypothesis of no cointegration for panel data. This test is similar to the approach adopted in Engle-Granger (EG) step procedures and it is proposed to estimate the homogenous cointegrating relationship. The third test is the Johansen-Fisher cointegration test. Maddala and Wu (1999), using Fisher's test (1932), proposed an alternative method for testing cointegration in panel data by combining the results of the individual cross-section tests. The researchers have developed two tests based on the cointegration trace and maximum eigenvalue by Johansen (1988).

3.2.3 Panel FMOLS and DOLS Estimates

Once cointegration has been established between the examined variables, we proceed with the estimation of the long run relationship. According to Pedroni (2000) and Kao and Chiang (2000) the standard OLS estimation leads to a biased and inconsistent estimator when applied to cointegrated panels. Pedroni (2000) argued that only in the case that regressors are strictly exogenous the OLS estimators are unbiased and could be generally used for valid inferences. For this reason, we estimate

the long run relationship using the Fully Modified Ordinary Least Square (FMOLS) estimator proposed by Pedroni (1999, 2001) and the Dynamic Ordinary Least Square estimator recommended by Kao and Chiang (2000) and Mark and Sul (2002). The superior estimators allow for greater flexibility in the presence of heterogeneity in the examined cointegrated vectors (Pedroni, 1999, 2000, 2001, 2004).

For the FMOLS and DOLS estimators consider the following fixed effect cointegrated panel:

$$y_{it} = \alpha_i + \beta x_{it} + u_{it} \text{ for } i = 1, 2, \dots, N \text{ members and } t = 1, 2, \dots, T \quad (2)$$

where y_{it} is a matrix (1,1), β is a vector of slopes ($k,1$) dimension, α_i allows for the country specific fixed effects, u_{it} are the stationary disturbance terms. x_{it} ($k,1$) vector assumed to be an integrated process of order one for all i , where $x_{it} = x_{it-1} + e_{it}$.

The FMOLS and DOLS estimators consider both serial correlation and endogeneity problems, so they are preferable than the OLS estimator (Phillips, 1995). The FMOLS estimator is defined as:

$$\beta_{FM} = \left[\sum_{i=1}^N \sum_{t=1}^T (x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)' \right]^{-1} \left[\sum_{i=1}^N \left(\sum_{t=1}^T (x_{it} - \bar{x}_i)y_{it}^* + T\Delta_{EM}^* \right) \right] \quad (3)$$

where y_{it}^* is the transformed variable of y_{it} in order to achieve the endogeneity correction and Δ_{EM}^* is the serial correlation error correction term.

The DOLS is an extension of Stock and Watson (1993) estimator and is obtained from the following equation:

$$y_{it} = \alpha_i + \beta x_{it} + \sum_{j=-q}^{j=q} c_{ij} \Delta x_{i,t-j} + v_{it} \quad (4)$$

where α_i indicates the country specific effect, c_{ij} represents the lead or lag coefficient of explanatory variables at first differences. The DOLS defined as follows:

$$\beta_{DOLS} = \left[\sum_{i=1}^N \sum_{t=1}^T z_{it} z_{it}' \right]^{-1} \left[\sum_{i=1}^N \sum_{t=1}^T z_{it} y_{it}^* \right] \quad (5)$$

where $z_{it} = [x_{it} - \bar{x}_i, \Delta x_{i,t-q}, \dots, \Delta x_{i,t+q}]$ is $2(q+1) \times 1$ vector of regressors. Kao and Chiang (2000) supported that the DOLS estimator is less biased and has superior small sample properties compared with FMOLS estimator.

3.2.4 The VECM Granger Causality

Engle and Granger (1987) supported that the existence of cointegration between two $I(1)$ series, implies that there is at least one causality relation in one direction. Since our variables are cointegrated, we continue with the Vector Error Correction Model estimation in order to capture the short and long run dynamics between exports of goods and services, government debt and economic growth. The first step is to estimate the long run equilibrium relationship and save the residuals corresponding to the deviation from equilibrium point. On the second step the parameters of the short-run adjustment are estimated. The equations that are used to test Granger causality are the following:

$$\Delta GDP_{i,t} = a_{1,i} + \sum_{k=1}^p \beta_{1,1,i,k} \Delta GDP_{i,t-k} + \sum_{k=1}^p \beta_{1,2,i,k} \Delta EXP_{i,t-k} + \sum_{k=1}^p \beta_{1,3,i,k} \Delta GD_{i,t-k} + \lambda_{1,i} ECT_{i,t-1} + u_{1,i,t} \quad (6)$$

$$\Delta EXP_{i,t} = a_{2,i} + \sum_{k=1}^p \beta_{2,1,i,k} \Delta GDP_{i,t-k} + \sum_{k=1}^p \beta_{2,2,i,k} \Delta EXP_{i,t-k} + \sum_{k=1}^p \beta_{2,3,i,k} \Delta GD_{i,t-k} + \lambda_{2,i} ECT_{i,t-1} + u_{2,i,t} \quad (7)$$

$$\Delta GD_{i,t} = a_{3,i} + \sum_{k=1}^p \beta_{3,1,i,k} \Delta GDP_{i,t-k} + \sum_{k=1}^p \beta_{3,2,i,k} \Delta EXP_{i,t-k} + \sum_{k=1}^p \beta_{3,3,i,k} \Delta GD_{i,t-k} + \lambda_{3,i} ECT_{i,t-1} + u_{3,i,t} \quad (8)$$

Where Δ is the first difference operator, $k = 1, 2, \dots, p$ is the optimal lag selected by the Schwarz, $ECT_{i,t-1}$ is the estimated lagged error correction term derived from the long run cointegration equation, $\lambda_{j,i}$ is the adjustment coefficient ($j = 1, 2, 3, 4$) and $u_{j,i,t}$ is the disturbance term assumed to be uncorrelated with zero means.

4. Empirical Results

In the empirical analysis we use annual data concerning Exports of Goods and Services (EXP), Government Debt (GD) and Gross Domestic Product (GDP) for three Eurozone countries (GR, IT, POR). We begin by testing the stationarity of these variables.

4.1 Panel Unit Root Tests

The preliminary step in analyzing the relationship between GDP, EXP and GD is to check the stationary properties of the underlying series. In the current paper, the unit root tests of LLC, Breitung, IPS, ADF-Fisher, PP-Fisher and Hadri have been applied to the panel of three countries (GR, IT, POR). The results of level and first difference unit root tests for the three variables are provided in Table 3.

Table 3. Panel Data Unit Root Tests Results

Level Unit Root Test Results			GDP	EXP	GD
Panel Level Series	LLC	Individual intercept	-2.028 (0.021)**	-0.262 (0.396)	0.226 (0.589)
		Individual intercept and trend	2.545 (0.994)	-1.471 (0.070)	-0.312 (0.377)
		Individual intercept			
	Breitung	Individual intercept	1.841 (0.967)	-1.613 (0.053)	1.344 (0.910)
		and trend			
		Individual intercept			
	IPS	Individual intercept	-0.730 (0.232)	1.527 (0.935)	2.366 (0.991)
		Individual intercept	2.328 (0.990)	-0.972 (0.165)	0.774 (0.780)
		and trend			
	ADF	Individual intercept	6.798 (0.339)	1.793 (0.937)	0.753 (0.993)
		Individual intercept	4.517 (0.607)	9.687 (0.138)	2.338 (0.886)
		and trend			

Panel First Difference Series	PP	Individual intercept	6.588 (0.360)	2.664 (0.849)	0.677 (0.995)
		Individual intercept and trend	0.039 (1.000)	5.711 (0.456)	2.439 (0.875)
	Hadri	Individual intercept	4.522 (0.000)***	6.111 (0.000)***	6.509 (0.000)***
		Individual intercept and trend	4.447 (0.000)***	4.441 (0.000)***	1.728 (0.041)**
	First Difference Unit Root Test Results				
	LLC		GDP	EXP	GD
		Individual intercept	-2.324 (0.010)**	-6.804 (0.000)***	-3.327 (0.000)***
		Individual intercept and trend	-1.953 (0.025)**	-2.290 (0.011)**	-3.009 (0.001)***
		Individual intercept			
	Breitung	Individual intercept	-0.933	-2.720	-2.308
		and trend	(0.175)	(0.003)***	(0.010)**
	IPS	Individual intercept	-2.016 (0.021)**	-5.682 (0.000)***	-3.398 (0.000)***
		Individual intercept and trend	-2.715 (0.003)***	-4.244 (0.000)***	-2.619 (0.004)***
	ADF	Individual intercept	14.163 (0.027)**	38.238 (0.000)***	23.045 (0.000)***
		Individual intercept and trend	18.903 (0.004)***	26.656 (0.000)***	16.846 (0.009)***
	PP	Individual intercept	14.218 (0.027)**	53.550 (0.000)***	22.807 (0.000)***
		Individual intercept and trend	13.538 (0.035)**	48.267 (0.000)***	16.922 (0.009)***
	Hadri	Individual intercept	3.480 (0.000)***	0.717 (0.236)	0.157 (0.437)
		Individual intercept and trend	2.902 (0.001)***	6.178 (0.000)***	3.537 (0.000)***

Note. Panel data include all countries. The numbers in parentheses denote p-values. ***, **, denotes rejection of null hypothesis at the 1% and 5% level of significance, respectively. The null hypothesis of these tests is that the panel series has a unit root (nonstationary series) except with the Hadri test which has no unit root in panel series. Lag length selection automatic based on Schwarz criterion.

As can be seen from Table 3 the results show that three variables are non-stationary in their level either with an intercept or with both intercept and trend. Evidently, the results indicated that all variables are stationary in their first differences (i.e., $I(1)$).

4.2 Panel Cointegration Tests

Since the order of integration has been confirmed, we proceed applying panel cointegration methodologies to test whether there is long-run relationship between the examined variables. The results of panel cointegration tests proposed by Pedroni (1999, 2004), Kao (1999) and Maddala and Wu (1999) are reported in the next Table.

Table 4. Panel Cointegration Tests Results

Pedroni residual cointegration test (GDP as dependent variable)				
	Test statistic	Probability		
Within Dimension				
Panel v	1.055	0.145		
Panel rho	-1.289*	0.098		
Panel PP	-1.855**	0.031		
Panel ADF	-1.814**	0.034		
Between Dimension				
Group rho	0.147	0.558		
Group PP	-0.598	0.274		
Group ADF	-2.041**	0.048		
Kao residuals cointegration test (GDP as dependent variable)				
	t-statistic	Probability		
ADF	-2.231***	0.012		
Johansen-Fisher Panel Cointegration Test				
	Fisher Stat. (trace test)	Probability	Fisher Stat. (max eigen test)	Probability
None	18.51***	0.005	18.27***	0.005
At most 1	5.691	0.458	4.729	0.579
At most 2	9.226	0.161	9.226	0.161

Note. The null hypothesis is that the variables are not cointegrated. Under the null tests, all variables are distributed normal, $N(0,1)$. ***, ** and * show significance at 1%, 5% and 10% levels, respectively. Fisher's test (1932) applied regardless of the dependent variable. Lag intervals for test: 1 2. Asymptotic p-values are computed using X^2 distribution.

The results from Table 4 support the presence of a cointegrated relationship between the three variables. The null hypothesis of no cointegration is rejected at panel level with all three methods. In Pedroni and Kao cointegration tests GDP is used as dependent variable. In the other cases, the probabilities are not statistically significant. We conclude that there is a cointegrated relationship between the three variables. In other words, the results show that GDP, EXP and GD are moving together in the long run.

4.3 Panel FMOLS and DOLS Estimates

Since our variables are cointegrated, we continue with the estimation of the parameters of the long-run equilibrium relationship. The results of Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) estimations are provided in Table 5.

Table 5. Panel FMOLS and DOLS Estimations Results for the Group of Countries (GDP as Dependent Variable)

FMOLS	Independent Variables		DOLS	Independent Variables	
	EXP	GD		EXP	GD
Coefficients	2.858 (13.190)***	-0.305 (-7.751)***	2.873 (11.473)***	-0.312 (-7.041)***	
R ²	0.994		0.997		
Adj. R ²	0.993		0.996		

Note. The numbers in parentheses denotes t-statistic. Asymptotic distribution of t-statistic is standard normal as T and N go to infinity. *** shows significance at 1% level. Lag and lead method selected by Akaike in DOLS.

Table 5 reports the estimated parameters from the long run equation where GDP is the dependent variable. In the other cases the coefficients are not statistically significant and the signs do not agree with the economic theory. The results show that exports have a positive effect on economic growth at 1% level of significance while government debt has a negative impact on economic growth at 1% level of significance.

4.4 The VECM Granger Causality

After establishing the status of unit root and cointegration we continue applying panel Granger causality test, based on VECM, in order to find the causality direction between the examined variables. The results for the short and long run causality relationships are summarized in Table 6.

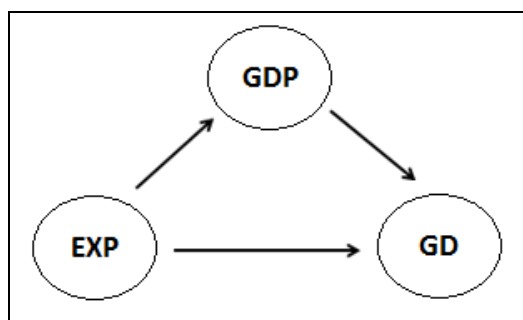
Table 6. Panel Causality Tests Results

Dependent Variable	Source of Causation (independent variables)			t-test
	F-statistic			
	Short-run			Long-run
	Δ GDP	Δ EXP	Δ GD	ECT
Δ GDP		3.741**	0.028	2.230**
Δ EXP	0.910		0.855	1.329
Δ GD	5.318***	4.041**		3.354***

Note. Δ denoted the first difference operator, *** and ** show significance at 1% and 5% levels, respectively. Short-run causality is determined by the statistical significance of the partial F-statistics associated with the right hand side variables. Long-run causality is revealed by the statistical significance of the respective error correction terms using a t-test.

We begin our analysis with the short run causality results. From the results of Table 6 we see that there is a short run unidirectional causal relationship from EXP to GDP and from EXP and GDP to GD. This means that in the short run, GDP and GD are affected by EXP. Also, the results show that GD is affected by GDP.

In the long run, the estimated coefficients of ECT in equations of DGDP and DGD are statistically significant at 5% and 1% respectively. We can point out that gross domestic product and government debt could play an important adjustment role in the long run equilibrium. So, we can say that there is a long run unidirectional causality running from exports to GDP as well as from exports and GDP to government debt (see Figure 2).

**Figure 2. Panel Data Granger Causality Relations for Three Countries**

5. Conclusion and Policy Implications

The global financial crisis has influenced and continues to influence negatively most of the European countries. The problems of the crisis appear more intense in the southern European countries, since it was difficult or impossible for some of them to repay or refinance their debt without the assistance of

the European Central Bank (ECB) or the International Monetary Fund (IMF). Debt problems, the risk of bankruptcy of their national banks, budget deficit, high unemployment rates and political instability are some of the main problems that these countries have to deal with. All the above, have shaken the financial stability of European Union and Euro area and have raised questions about their durability.

The purpose of this study is to examine the factors that can reduce the external debt in order to enhance growth and exports, which in turn will promote investments and will strengthen competitiveness. The increase in debt has negative effects on the financial performance of these three countries, considering that reduced growth rates weaken their debt service ability. In 2014, Greece, Italy and Portugal were the three Eurozone countries with the highest government debt-GDP ratio. To our knowledge, there are very few econometric studies that examine the causal relationship between these three variables and carried out their analysis following a panel framework. In this study, we apply panel unit root tests, panel cointegration tests and dynamic panel causality test with error correction model in order to find the causal links among the examined variables.

Findings suggest that there is a strong evidence of cointegration between the three variables, which indicates that there is a long run equilibrium relationship. The FMOLS and DOLS methods are used for the estimation of the long run relationship. The obtained results, for the group of countries, show that exports affect positively economic growth in 1% level of significance. On the other hand, government debt has a negative effect on economic growth at 1% level of significance.

Causality results show that there is a long run unidirectional causality running from exports to GDP as well as from exports and GDP to government debt. Findings suggest that exports are an important factor for increasing economic growth and that government debt is affected by exports and economic growth. Also, we can say that exports have an indirect effect to government debt through GDP. Our results provide evidence to support the export led-growth hypothesis.

So, the governments of these countries should implement policies to stimulate their exports since they constitute an important factor for national development. Each government should implement a long term export promotion plan with specific objectives and with sector and product priorities. This plan should be an integral part of an overall industrialization strategy and should be implemented systematically and independently of any political developments. In addition, the policy makers have to cooperate with exporters providing them with the necessary market and industry information and training them according the global standards. The role of higher education is a key factor in order to be created high qualified and competitive export oriented business. Finally, for countries with small production base, such as Greece and Portugal, profits should come from added value and from markets with specific characteristics which are willing to pay more.

A proper long term export strategy is not the only factor for the promotion of economic development. This strategy has to be linked with other policy tools. The way that the countries plan their exports strategy differs according to the cultural, political environment, legal environment and the stage of economic development (Seringhaus & Rosson, 1990).

In the current economic environment, the results of this study support a further argument for the reduction of the debt of all three countries. If the policy makers retain the debt at high levels, fearing that the fiscal consolidation measures will not be liked by the voters, they will undermine the growth prospects and will place an additional burden on fiscal sustainability.

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Appendix A

Levin-Lin-Chu Test (2002)

Levin-Lin-Chu Test (2002) suggested the following hypotheses:

H_0 : Each time series contains a unit root or $H_0 : \rho = 1$

H_1 : Each time series is stationary or $H_0 : \rho < 1$

The procedure works as follows:

First, we run augmented Dickey-Fuller (ADF) for each cross-section on the equation:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{L=1}^{p_i} \beta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it}$$

In the second step, we run two auxiliary regressions:

Δy_{it} on Δy_{it-L} and d_{mt} to obtain the residuals $\hat{\varepsilon}_{it}$ and

y_{it-1} on Δy_{it-L} and d_{mt} to get residuals \hat{v}_{it-1}

The third step involves standardization of the residuals by performing

$$\hat{\varepsilon}_{it} = \frac{\hat{\varepsilon}_{it}}{\hat{\sigma}_{\varepsilon_i}} \quad \text{and} \quad \hat{v}_{it-1} = \frac{\hat{v}_{it-1}}{\hat{\sigma}_{\varepsilon_i}}$$

Finally, we run the pooled OLS regression

$$\hat{\varepsilon}_{it} = \rho \hat{v}_{it-1} + \hat{\varepsilon}_{it}$$

The null hypothesis is $H_0 : \rho = 0$ (see Levin, Lin, & Chu, 2002).

Im-Pesaran-Shin (2003)

The Im-Pesaran-Shin test is not as restrictive as the Levin-Lin-Chu test, since it allows for heterogeneous coefficients. The null hypothesis is that all individuals follow a unit root

process: $H_0 : \rho = 0 \quad \forall i$

The alternative hypothesis allows some (but not all) of the individuals to have unit roots:

$$H_1 : \begin{cases} \rho_i < 0 & \text{for } i = 1, \dots, N_1 \\ \rho_i = 0 & \text{for } i = N_1 + 1, \dots, N \end{cases}$$

When t_{ρ_i} is the individual t-statistic for testing the null hypothesis $\rho_i = 0$ for all i , then the test is based on averaging individual unit root tests $\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{\rho_i}$. If this statistic is properly standardized, it is

asymptotically $N(0,1)$ distributed. Monte Carlo simulations reveal that the small sample performance of the Im-Pesaran-Shin test is better than Levin-Lin-Chu test. If either N is small or if N is large relative to T , then both Im-Pesaran-Shin and Levin-Lin-Chu show size distortions. Additionally, the tests have little power if deterministic terms are included in the analysis (Kunst, 2009).

Breitung (2000)

The procedure of the Breitung's test can be described as follows.

First, we run augmented Dickey-Fuller (ADF) for each cross-section on the equation:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{L=1}^{p_i} \beta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad (\text{except that we do not include deterministic terms}).$$

In the second step, we run two auxiliary regressions:

$$\begin{aligned} \Delta y_{it} &\text{ on } \Delta y_{it-L} \text{ and } d_{mt} \text{ to obtain the residuals } \hat{\varepsilon}_{it} \text{ and} \\ y_{it-1} &\text{ on } \Delta y_{it-L} \text{ and } d_{mt} \text{ to get residuals } \hat{v}_{it-1} \end{aligned}$$

The third step orthogonalization transformation is applied to the residuals $\hat{\varepsilon}_{it}$ such that we obtain $\hat{\hat{\varepsilon}}_{it}$.

Finally, we run the pooled OLS regression $\hat{\hat{\varepsilon}}_{it} = \rho \hat{v}_{it-1} + \hat{\hat{\varepsilon}}_{it}$ which is asymptotically $N(0,1)$ distributed.

The null hypothesis is $H_0: \rho = 0$.

Fisher-type Test

The Fisher-type test uses p-values from unit root tests for each cross-section i . The formula of the test looks as follows:

$$P = -2 \sum_{i=1}^N \ln p_i$$

The test is asymptotically chi-square distributed with $2N$ degrees of freedom ($T_i \rightarrow \infty$ for finite N). A big benefit is that the test can handle unbalanced panels. Furthermore, the lag lengths of the individual augmented Dickey-Fuller tests are allowed to differ. A drawback of the test is that the p-values have to be obtained by Monte Carlo simulations (Kunst, 2009).

Maddala and Wu (1999)

Maddala and Wu (1999) proposed the use of the Fisher p_λ test which is based on combining the p-values of the test-statistic for a unit root in each cross-sectional unit. Let π_i be the p-value from the i th-test such that π_i are $U[0, 1]$ and independent, and $-2 \log_e \pi_i$ has a χ^2 distribution with 2 degrees of freedom. So, $p_\lambda = -2 \sum_{i=1}^N \log_e \pi_i$ has a χ^2 distribution with $2N$ degrees of freedom. The null and

alternative hypotheses are the same as in the IPS test. Applying the ADF estimation equation in each cross-section, we can compute the ADF t-statistic for each individual series, find the corresponding p-value from the empirical distribution of ADF t-statistic (obtained by Monte-Carlo simulation), and compute the Fisher-test statistics and compare it with the appropriate χ^2 critical value (Hoang &

McNown, 2006).

Hadri (2000)

Hadri (2000) residual based Lagrange Multiplier (LM) test for the null that the time series for each i are stationary around a deterministic trend against the alternative of a unit root in panel data.

$$y_{it} = r_{it} + \beta_{it}t + \varepsilon_{it}$$

where β_{it} is the deterministic component r_{it} is a random walk, $r_{it} = r_{it-1} + u_{it}$, ε_{it} is a stationary process, and $u_{it} \rightarrow IID(0, \sigma_u^2)$, $t = 1, 2, \dots, T$ and $i = 1, 2, \dots, N$ are the observed series for which we

wish to test stationarity for all i . So, $y_{it} = \beta_{it}t + e_{it}$, $e_{it} = \sum_{j=1}^t u_{ij} + \varepsilon_{it}$ and $E[e_{it}] = 0$. Let \hat{e}_{it}

be the residuals and $\hat{\sigma}_e^2$ is a consistent estimator of σ_e^2 under H_0 . More specifically, the test takes the following form:

$H_0 : \lambda = 0$ against $H_1 : \lambda > 0$ where $\lambda = \frac{\sigma_u^2}{\sigma_e^2}$ The LM statistic is:

$$LM = \frac{\frac{I}{N} \sum_{i=1}^N \frac{1}{T^2} \sum_{t=1}^T S_{it}^2}{\hat{\sigma}_e^2} \quad \text{where} \quad S_{it} = \sum_{j=1}^t \hat{e}_{ij} \quad \text{and} \quad \hat{\sigma}_e^2 = \frac{1}{NT} \sum_{i=1}^N \sum_{t=1}^T \hat{e}_{it}^2$$